New High Thermal Conductivity Seats and Guides from Federal-Mogul Powertrain Keep Engine Valves Cooler

Improved heat transfer reduces valve temperatures by up to 70°C

BURSCHEID, Germany, Aug. 10, 2017 /PRNewswire/ -- Federal-Mogul Powertrain will debut new materials for valve seats and guides with improved thermal conductivity at the 2017 IAA Show in Frankfurt, Germany. Suitable for series production, the new High Thermal Conductivity (HTC) materials and Thermal Interface Material (TIM) coating can reduce valve head temperatures by up to 70°C, allowing improved combustion and lower emissions.

"The extreme valve temperatures experienced on today's highly boosted downsized engines can lead to reduced valve fatigue life and critical valve guide and stem seal temperatures, resulting in the need for expensive valve steel alloys. If late ignition timing is used to reduce knock and enrichment is protecting components from critical temperatures, CO₂ emissions are increased," explained Gian Maria Olivetti, Chief Technology Officer, Federal-Mogul Powertrain. "By reducing the valve head temperatures we help to eliminate these issues, and by developing technologies suitable for series production, we are able to support mass market applications." HTC can also contribute in obtaining a more even circumferential temperature distribution on the valve seat insert and surrounding cylinder head material, eliminating local hot spots for the benefit of wear reduction and decrease of temperature-related distortion.

How better heat transfer means cooler valves

The seat insert is the primary heat path from the valve head into the cylinder head cooling jacket. By conducting more heat away from the valve head, the new seat materials reduce the temperature in the hottest part of the combustion chamber and lower the gas temperature at the end of the compression stroke: improving knock resistance and allowing a wider range of ignition advance to enable optimisation of combustion. The materials also enable CO₂ emissions reduction by eliminating the need for fuel enrichment as a means of cooling. For exhaust valve head alloys, every 20°C reduction in temperature negates the need for an upgrade to the next, more expensive alloy specification.

The valve guide is the main heat path from the valve stem to the cylinder head. By conducting more heat away from the valve stem, the new valve guide material reduces local temperatures to below the critical thresholds at which the valve stem seals and lubricating oil begin to break down.

HTC materials for enhanced heat dissipation

Federal-Mogul Powertrain's HTC materials are powder metal formulations used in both seat inserts and guides, and the specifications are highly configurable. Valve seats employ copper infiltration to improve heat transfer; valve guides, which see lower temperatures and require porosity in order to retain oil, use a subtle combination of free copper particles and fine interconnected copper alloys. In the case of dual layer composite valve seat inserts, the secondary material of the insert is no longer simply a low cost 'carrier' for the functional seating layer which contacts the valve head; it serves an engineering purpose by conducting more heat away from the valve head.

TIM coating – a differentiator

Federal-Mogul Powertrain's TIM coating greatly improves the heat transfer across the boundary between the
seat insert or guide and the cylinder head by filling the interstitial spaces between the irregularities of the opposing surfaces. This eliminates the minute air pockets that normally interrupt the heat path and improves the conformability against the cylinder head surface. HTC materials can reduce valve temperature, but test results show that in some engines TIM coating can offer a significantly greater reduction, as it is acting as a thermal bridge, removing the barrier between the two components. A copper-based coating, TIM needs a suitable sequence of pre-treatments in order to be effective and required significant development by Federal-Mogul Powertrain to ensure good adhesion even on porous surfaces, without impairing the thermal conductivity benefit.

"Successful development of the TIM coating for series manufacturing means that the technology can be adopted immediately by our customers," said Denis Christopherson, Federal-Mogul Powertrain's Valve Seats and Guides Group Director of Research and Development. "By improving heat flow across the boundary between the cylinder head and the insert, TIM coating allows the heat transfer benefits of HTC to be fully realized."

**Backed by test results**

Testing carried out at Federal-Mogul Powertrain's Burscheid, Germany test center on state-of-the-art, highly rated turbocharged gasoline engines with direct injection has shown the effectiveness of the new materials. A combination of HTC and TIM technologies reduced peak inlet valve head temperatures by between 26 and 32°C. The improvement in exhaust valve head temperatures was even more marked; on a solid valve the peak was reduced by up to 70°C and on a hollow, sodium-filled valve, by up to 67°C. The test results have been used to correlate predictions from Federal-Mogul Powertrain's advanced thermal simulation programs. These allow future applications to be accurately assessed, and optimum materials selected, while the engine design only exists in an early concept stage.

HTC and TIM materials are production-ready and sample components of valve seat inserts and guides are undergoing preliminary testing with several customers. Federal-Mogul Powertrain received a first nomination with intended start of production in 2018. Though primarily intended for highly rated gasoline applications, they could be equally beneficial for exhaust valve seats and guides on high performance turbo diesels and for heavy-duty diesel engines. Federal-Mogul Powertrain will exhibit the new materials, alongside many of its other products at the IAA Show from 12-15 September (Press and Trade days only) at Booth E33 in Hall 4.1.

**About Federal-Mogul**

Federal-Mogul LLC is a leading global supplier of products and services to the world's manufacturers and servicers of vehicles and equipment in the automotive, light, medium and heavy-duty commercial, marine, rail, aerospace, power generation and industrial markets. The company's products and services enable improved fuel economy, reduced emissions and enhanced vehicle safety.

Federal-Mogul operates two independent business divisions, each with a chief executive officer reporting to Federal-Mogul's Board of Directors.

Federal-Mogul Powertrain designs and manufactures original equipment powertrain components and systems protection products for automotive, heavy-duty, industrial and transport applications.

Federal-Mogul Motorparts sells and distributes a broad portfolio of products through more than 20 of the world's most recognized brands in the global vehicle aftermarket, while also serving original equipment vehicle manufacturers with products including braking, wipers and a range of chassis components. The company's aftermarket brands include ANCO® wipers; Beck/Arnley® premium OE quality parts and fluids;
BERU® ignition systems; Champion® lighting, spark plugs, wipers and filters; Interfil® filters; AE®, Fel-Pro®, FP Diesel®, Goetze®, Glyco®, National®, Nüral®, Payen®, Sealed Power® and Speed-Pro® engine products; MOOG® chassis components; and Abex®, Ferodo®, Jurid® and Wagner® brake products and lighting.

Federal-Mogul was founded in Detroit in 1899 and maintains its worldwide headquarters in Southfield, Michigan. The Company has nearly 53,000 employees in 24 countries. For more information, please visit www.federalmogul.com.

*BERU is a registered trademark of BorgWarner Ludwigsburg GmbH

CONTACT:
Ursula Hellstern
Federal-Mogul Powertrain Communications
+49 (611) 201 9190
ursula.hellstern@federalmogul.com

SOURCE Federal-Mogul Powertrain

Additional assets available online: Photos (2)